

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)								DATE February 1999		
BUDGET ACTIVITY 3 - Advanced Technology Development				PE NUMBER AND TITLE 0603606A Landmine Warfare and Barrier Advanced Technology						
COST (In Thousands)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	30529	23777	47456	44935	49684	50305	71316	101799	Continuing	Continuing
D608 Countermines & Barrier Development	20317	21790	27726	18327	20151	20785	22189	23318	Continuing	Continuing
D624 Ground Penetrating Radar Technology	3654	1987	0	0	0	0	0	0	0	8531
D674 Airborne Standoff Minefield Detection System	6558	0	0	0	0	0	0	0	0	6558
D683 Anti-Personnel Landmine (APL) Alternatives	0	0	19730	26608	29533	29520	49127	78481	Continuing	Continuing

A. Mission Description and Budget Item Justification: This program element provides for the development and demonstration of countermines technologies. Advanced Technology Demonstrations (ATDs), advanced warfighting experiments, and modeling and simulation will be conducted to verify the system of systems approach, providing support for the shallow water/beach/land assault phase (Demo II) of the Navy, Army, and USMC joint countermines advanced concept technology demonstration (ACTD). The specific efforts include remote detection of minefields and detection of individual mines from moving vehicles and aerial platforms, all of which must work against both traditional (metallic) mines and mines made from advanced materials. Breaching techniques will be developed for both conventional and electronically activated mines that can act at a distance. Operation Desert Storm and the humanitarian operations in Somalia have highlighted the need for new equipment to detect and neutralize land mines. The Army's highest priority requirements are in-stride detection and breaching, and close-in detection and neutralization of landmines. Multi-sensor fusion will be used in vehicle-mounted mine detectors and airborne multispectral/hyperspectral minefield detectors to sense surface-laid and buried mines. Alternative systems for anti-personnel landmines will also be explored. The Army has focused its resources and is expediting these programs in coordination with the US Marine Corps. The work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and adheres to Tri-Service Reliance Agreements on conventional air/surface weapons and ground vehicles. Work in this program element is related to and fully coordinated with PE 0603691A (Landmine Warfare and Barrier Advanced Development), PE 0602784A (Military Engineering Technology), PE 0602712A (Countermines Technology), and PE 0602709A (Night Vision and Electro-Optics Technology). This program is managed primarily by the Communications-Electronics Research, Development and Engineering Center (CERDEC), Night Vision Electronic Sensors Directorate (NVESD), Fort Belvoir, VA.

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DATE

February 1999

BUDGET ACTIVITY

3 - Advanced Technology Development

PE NUMBER AND TITLE

**0603606A Landmine Warfare and Barrier
Advanced Technology**

B. Program Change Summary	<u>FY 1998</u>	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>
Previous President's Budget (<u>FY 1999</u> PB)	31581	21944	36044	19559
Appropriated Value	32932	23944		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-1351	-167		
b. SBIR / STTR	-791			
c. Omnibus or Other Above Threshold Reductions	-261			
d. Below Threshold Reprogramming				
e. Rescissions				
Adjustments to Budget Years Since <u>FY 1999</u> PB			+11412	+25376
Current Budget Submit (<u>FY 2000 / 2001</u> PB)	30529	23777	47456	44935

Change Summary Explanation: Funding - FY 1999 – Congressional add for Ground Penetrating Radar (+2000).

FY 2000/2001 – Funding increased to develop anti-personnel landmine alternatives (APLA).

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BUDGET ACTIVITY 3 - Advanced Technology Development				PE NUMBER AND TITLE 0603606A Landmine Warfare and Barrier Advanced Technology					PROJECT D608	
COST <i>(In Thousands)</i>	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D608 Countermine & Barrier Development	20317	21790	27726	18327	20151	20785	22189	23318	Continuing	Continuing

Mission Description and Justification: This project provides advanced technology demonstrations of countermine capabilities. The specific efforts include remote detection of minefields, detection of individual mines from moving vehicles and aerial platforms, all of which must work against both traditional (metallic) mines and mines made from advanced materials. Multi-sensor fusion will be used in the vehicle-mounted mine detector ATD and airborne multispectral/hyperspectral minefield detector to sense surface-laid and buried mines. A new generation of standoff sensors and explosive/directed energy mine neutralization technologies will be integrated in a Mine Hunter/Killer ATD. The Mine Hunter/Killer will be capable of detecting and destroying mines at maneuver speeds. This project supports advanced warfighting experiments and modeling and simulation that are key elements of the shallow water/beach/land assault phase of the Navy, Army, and USMC joint countermine Advanced Concept Technology Demonstration (ACTD).

FY 1998 Accomplishments:

- 7293 – Analyzed data from joint countermine ACTD demo I, applied lessons learned to demo II planning, and executed demo II.
- Assessed contribution of new countermine technology to survivability of convoy/rear area assets, in battle lab experiment.
- Added fidelity to joint countermine ACTD novel system models and conducted sensitivity studies; completed modeling of false targets for detection systems and transitioned to joint countermine operational simulation. Continued validation and verification activities.
- 3000 – Completed development of three vehicular mounted mine detector prototypes with alternative multisensor fusion design approaches, conducted comparative performance testing, and selected system(s) for final Vehicular Mounted Mine Detector (VMMD) ATD.
- Completed vehicular mounted mine detector ATD and transitioned program design and test documentation to ground standoff mine detection system engineering and manufacturing development program.
- 7496 – Studied neutralization technologies for the mine hunter/killer and completed restructured plans for mine hunter/killer ATD execution.
- Performed development of advanced standoff ground penetrating radar (GPR) sensor to allow greater standoff mine detection distances and faster forward speeds.
- 2528 – Standardized three vehicular mounted mine detector prototypes by incorporating electronic marking capability, common platforms, and GPS capabilities.
- Completed demonstration and performance characterizations of alternative vehicular mounted mine detectors.
- Total 20317

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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603606A Landmine Warfare and Barrier Advanced Technology	PROJECT D608
<p>FY 1999 Planned Program:</p> <ul style="list-style-type: none"> • 2689 – Develop models and simulations for joint countermine ACTD technologies and integrate into service models with new architecture, continue verification and validation. Receive final user report on novel system military suitability. <ul style="list-style-type: none"> – Conduct assault-on-objective battle lab experiment and assess contribution of new countermine technology to survivability and mobility of assault forces. • 8885 – Fabricate prototype “stand-off” GPR for integration with mine hunter/killer demonstrator. <ul style="list-style-type: none"> – Integrate prototype detection and neutralization technologies into mine hunter/killer ATD. – Complete contractor testing on mine hunter/killer platform. – Complete site preparation for the mine hunter/killer ATD. • 9697 – Complete requirements analysis, definition of aircraft constraints and interfaces, and technology trade-offs for lightweight imaging multispectral airborne minefield detection technology. <ul style="list-style-type: none"> – Collect mine signature data to support finalization of phenomenology studies and mine detection algorithm development. – Develop critical components for multispectral minefield detection sensor. • 519 – Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs. <p>Total 21790</p> <p>FY 2000 Planned Program:</p> <ul style="list-style-type: none"> • 9510 – Evaluate mine hunter/killer integration of close-in detection and neutralization capability with a goal of dramatically improving the rate at which maneuver/transport lanes are cleared versus current capabilities. <ul style="list-style-type: none"> – Demonstrate and evaluate tele-operation capability of mine hunter/killer for an off-route mission scenario. – Develop and evaluate precision neutralization technologies against surface and buried AT mines in various soils, overburden and environmental conditions with goal of demonstrating greater than a 90% probability of kill for a neutralization capability. – Conduct constructive and virtual modeling and simulation to evaluate and refine future mine hunter/killer capabilities for on and off-route scenarios. • 14408 – Develop minefield detection aided target recognition (AiTR) algorithms to improve airborne minefield detection performance (increase probabilities of detection and reduce false detection rates). <ul style="list-style-type: none"> – Perform ground and airborne data collections using multiple sensors that will provide data to support phenomenology investigations, multi/hyperspectral AiTR algorithm development and algorithm performance evaluations for ground and airborne mine/minefield detection sensors. – Develop system and component requirements/specifications and preliminary design of lightweight multi/hyperspectral minefield detection sensor that will be compatible with future tactical or short range UAVs (weight goal less than 65 lbs.) and capable of performing in a broad range of environments. 		
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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603606A Landmine Warfare and Barrier Advanced Technology	PROJECT D608
<p>FY 2000 Planned Program: (continued)</p> <ul style="list-style-type: none"> – Perform benchmark demonstration of the multi/hyperspectral minefield detection capability to establish multi/hyperspectral minefield detection performance baseline. <p>3808 – Analyze data from joint countermine ACTD demo II, apply lessons learned to technology programs and provide support for residual hardware.</p> <p>– Leverage lessons learned in humanitarian demining program through DOD assessment of utility in military area clearance operations.</p> <p>Total 27726</p> <p>FY 2001 Planned Program:</p> <ul style="list-style-type: none"> • 3490 – Develop data collection and analysis plans. Obtain HSTAMIDS and GSTAMIDS sensor suites and other candidate sensor technologies for data collections for investigations in background analyses and false alarm reductions for mine detection technologies. <ul style="list-style-type: none"> – Refurbish data collection sites; collect data and review for applicability and exploitation • 14837 – Fabricate, build, and integrate lightweight multi/hyperspectral sensor that will be TUAV compatible (weight goal less than 65 lbs.) and capable of performing in a broad range of environments. <ul style="list-style-type: none"> – Develop advanced minefield detection AiTR algorithms and enhance fusion approaches to improve airborne minefield detection (increase probabilities of detection and reduce false detection rates). – Integrate TUAV system with lightweight sensor and real-time minefield detection AiTR algorithms to demonstrate the ability to achieve the Army's airborne minefield detection requirements. – Develop and design a test and evaluation strategy that will fully test the lightweight multi/hyperspectral technology's ability to achieve the Army's airborne minefield detection requirements. <p>Total 18327</p>		
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BUDGET ACTIVITY 3 - Advanced Technology Development				PE NUMBER AND TITLE 0603606A Landmine Warfare and Barrier Advanced Technology					PROJECT D624	
COST (In Thousands)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D624 Ground Penetrating Radar Technology	3654	1987	0	0	0	0	0	0	0	8531
<p><u>Mission Description and Justification:</u> This Congressional special interest program provided for the development and evaluation of stand-off ground penetrating radar (GPR) technologies for mine detection. Continued development of standoff mine detection capabilities will be funded in this PE in project D608 in FY00 and beyond.</p> <p>FY 1998 Accomplishments:</p> <ul style="list-style-type: none"> • 3654 – Completed efforts to enhance GPR detection algorithm performance, using detection algorithm test results. – Completed additional testing and evaluation of standoff GPR detector performance in vehicular mounted mine detector test scenarios. <p>Total 3654</p> <p>FY 1999 Planned Program:</p> <ul style="list-style-type: none"> • 1934 – Upgrade Phase I system for Phase II forward looking system. – Enhance power amplifiers for better antenna gain and improve digitizers for increased processing capability. – Enhance and integrate GPS system for inertial navigation and mine identification processing capability. – Upgrade software to improve performance of both GPR and FLIR sensors. • 53 – Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs. <p>Total 1987</p> <p>FY 2000 Planned Program: Program not funded in FY 2000</p> <p>FY 2001 Planned Program: Program not funded in FY 2001</p>										
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BUDGET ACTIVITY 3 - Advanced Technology Development				PE NUMBER AND TITLE 0603606A Landmine Warfare and Barrier Advanced Technology					PROJECT D674	
COST (In Thousands)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D674 Airborne Standoff Minefield Detection System	6558	0	0	0	0	0	0	0	0	6558
<p><u>Mission Description and Justification:</u> This Congressional special interest program provided for the development and evaluation of airborne minefield detection capabilities. Continued development of a multispectral / hyperspectral mine detection capability will be funded in this PE in project D608 in FY99 and beyond.</p> <p>FY 1998 Accomplishments:</p> <ul style="list-style-type: none"> • 6558 – Collected airborne mine and minefield data using infrared and multispectral/hyperspectral sensors to support development and refinement of robust mine detection algorithms. <ul style="list-style-type: none"> – Developed, integrated, and evaluated enhanced airborne mine detection algorithms. These enhanced algorithms will be capable of exploiting data from single color infrared sensors, as well as multispectral/hyperspectral imaging sensors. – Enhanced sensor imaging resolution and sensitivity, and assessed performance of the airborne mine detection sensor as a testbed. – Transitioned algorithm data and sensor characterizations to lightweight airborne multispectral minefield detection development program. <p>Total 6558</p> <p>FY 1999 Planned Program: Program not funded in FY 1999</p> <p>FY 2000 Planned Program: Program not funded in FY 2000</p> <p>FY 2001 Planned Program: Program not funded in FY 2001</p>										
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BUDGET ACTIVITY 3 - Advanced Technology Development				PE NUMBER AND TITLE 0603606A Landmine Warfare and Barrier Advanced Technology				PROJECT D683	

COST (In Thousands)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D683 Anti-Personnel Landmine (APL) Alternatives	0	0	19730	26608	29533	29520	49127	78481	Continuing	Continuing

Mission Description and Justification : This project provides advanced technology demonstrations of alternative systems for anti-personnel landmines (APLs). This includes alternatives to anti-personnel submunitions used in mixed anti-tank (AT) landmine systems and possibly the entire mixed landmine system themselves. The alternatives systems will include surveillance systems, command and control systems, and overwatch fires which will be evaluated and developed in parallel to provide similar capabilities that are now provided by APLs and APL submunitions in mixed AT systems. Distributed simulation will be used to evaluate new concepts and modify tactics and procedures. Prototype components and system architectures will be constructed and evaluated in system field tests. This effort continues the work started in PE 603121D8Z and concept exploration study congressional plus up in 604808A.

FY 1998 Accomplishments: Project not funded in FY 1998.

FY 1999 Planned Program: Project not funded in FY 1999.

FY 2000 Planned Program:

- 2000 - Complete concept exploration studies.
- 11730 - Evaluate the use of low cost sensors for remote detection, assessment and early warning of incoming targets. Leverage commercial and current military sensors and build prototypes for field test.
 - Evaluate current command, control, communications, and computer (C4) components and optimize implementation for use in landmine alternative system architecture. Include assessment of communications vulnerability, investigate novel low cost, short range communications devices for minefield components and sensor networking, and digitize minefield operations to provide situational awareness. Build prototypes for field test.
 - Evaluate the use of advance deterrent and fuzing systems including wide area munitions and nonlethal technology for insertion to landmines for anti-handling capability and/or to provide man-in-the-loop overwatch fire capability. Build prototypes for field tests.
- 3000 - Evaluate modifying current mixed system delivery systems for use with landmine alternative system concepts.
- 3000 - Use distributed modeling to modify tactics and procedures for landmine alternative system architectures.

Total 19730

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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603606A Landmine Warfare and Barrier Advanced Technology	PROJECT D683
<p>FY 2001 Planned Program:</p> <ul style="list-style-type: none"> • 5000 - Complete component field test and develop near term system architecture for landmine alternatives system. • 5000 - Modify and leverage on going development in advanced sensors, C4 components and advanced deterrent and nonlethal mechanisms to improve performance and operational utility of landmine alternative system concepts. -Utilize distributed simulations to modify systems concepts and model advance technology prototypes to refine landmine alternatives system. • 16608 - Weaponize alternative landmine system components and demonstrate in advanced warfighter field test. - Provide field harden prototypes for user tests. - Demonstrate artillery, air drop and other scatterable delivery mechanisms of landmine alternative system prototypes. - Demonstrate landmine alternative system C4 interfaces with digital battlefield. - Modify landmine alternative system architecture based on user feedback. <p>Total 26608</p>		
<p>Project D683</p> <p align="center"><i>Page 9 of 9 Pages</i></p> <p align="right">Exhibit R-2A (PE 0603606A)</p>		

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